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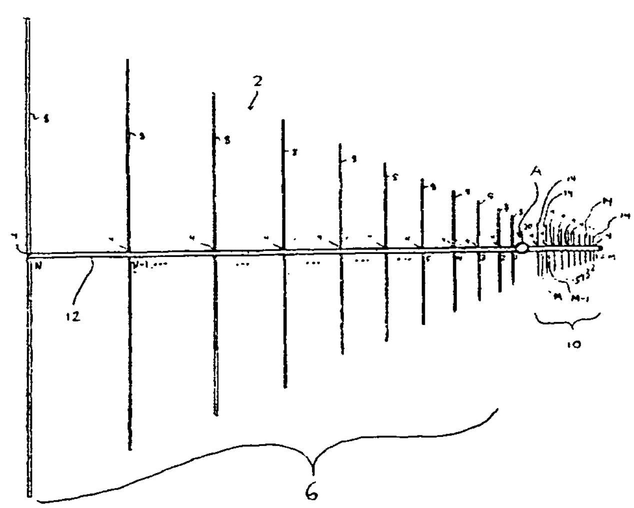
(54) Title: INTEGRAL ANTENNA FOR SATELLITE RADIO BAND, TELEVISION BAND AND FM RADIO BAND



(57) Abstract: An integral antenna that receives television and FM radio signals and satellite radio signals includes a multi-element antenna portion having a boom (12) supported by a mast (22) and a plurality of parallel, spaced apart dipole elements (2) supported by the boom (12) and extending perpendicularly to the longitudinal axis of the boom (12), and a helical antenna portion (20) having an element helically wound about a supporting core. The helically wound antenna portion (20) receives satellite radio signals, and the multi-element antenna portion (2) receives television and/or FM radio signals. The satellite radio antenna portion (20) is mounted at one of various "null-points" (4) situated on the multi-element antenna portion (2) where current flow in the multi-element antenna portion is minimal.

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INTEGRAL ANTENNA FOR SATELLITE RADIO BAND, TELEVISION BAND AND FM RADIO BAND

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on U.S. Provisional Application Serial No. 60/329,301, filed on October 15, 2001, entitled "Coupling Satellite Radio and TV, FM, and AM Onto a Single Antenna", the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to antennas, and more particular relates to a satellite radio antenna which is integrated with an antenna for receiving television and FM (frequency modulated) band signals.

Description of the Prior Art

Conventional broadcast radio signals have a very limited reception range, which is typically about 30 to 40 miles from the transmitter. Satellite radio or digital radio addresses this problem by broadcasting its signal, which may be received regardless of the listener's location, from multiple satellites.

Satellite radio has grown significantly in popularity and is for the most part associated with reception by automobile radio receivers. However, because of the unique programming and clear reception, due to digital signal transmission and reception, of satellite radio, there is believed to be a market and consumer demand for satellite radio by homeowners and apartment dwellers in their place of residence. Very often, such places of residence already have antennas in place for television band reception, including VHF (very high frequency) and UHF (ultra high frequency) bands, and FM (frequency modulated) radio band reception.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to integrate a satellite radio antenna with a pre-existing television broadcast and FM radio band antenna for home use.

It is another object of the present invention to provide an integrated satellite radio band/VHF/UHF television band/FM radio band antenna.

It is a further object of the present invention to provide an integrated satellite radio, television and FM radio antenna mountable on a single mast.

In accordance with one form of the present invention, a satellite radio antenna is combined with a television band and FM radio band antenna which are mounted on a single mast attached to a dwelling place in a position for optimum reception of transmitted signals falling within the satellite radio band, television band and FM radio band. Preferably, the satellite radio antenna is a helical antenna located within a radome or housing. Also, preferably, the television/FM radio antenna is a log-periodic antenna having one or more "null-points", at which point the satellite radio antenna is mechanically and/or electrically connected. The log-periodic antenna has a series of spaced apart reflector and radiator elements mounted on a central boom, which is supported by a mast securely attached to the dwelling place. The satellite radio antenna may be electrically and mechanically connected at one of the "null-points" along the boom of the log-periodic antenna.

These and other objects, features and advantages of this invention will become apparent from the following detailed description of illustrative embodiments thereof, which is to be read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a top view of a log-periodic antenna illustrating the various "null-points" where a satellite radio antenna may be connected thereto.

Figure 2 is a side view of an integral satellite radio/television/FM radio antenna formed in accordance with the present invention.

Figure 3 is an isometric view, in simplified form, of the satellite radio antenna portion which is electrically and/or mechanically coupled to the television/FM radio antenna to form the integrated antenna of the present invention.

Figure 4 is a partial isometric view of another form of the satellite radio antenna portion of the integral antenna formed in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The satellite digital audio radio system (SDARS) operates in a band of frequencies between 2320.5 and 2345 megahertz (MHz). The television reception band (VHF/UHF) covers the frequencies between 470 MHz and 806 MHz for the UHF band, and 54 MHz and 216 MHz for the VHF band. The FM radio band falls within the "VHF" television band between Channel 6 and Channel 7, and covers a frequency of about 88 MHz to 108MHz. An integrated antenna that contains elements needed for the reception of all of these services is desirable and provides an efficient method for reception and signal distribution.

The antennas used for satellite radio reception require line-of-sight views to the "sky"-based satellites. This places restrictions on the placement of the satellite radio antenna. The satellite radio antenna should be placed atop the television/FM radio antenna as shown in Figure 2 of the drawing. More specifically, Figure 2 shows an example of the position of the satellite radio antenna integrally built into a television and/or FM radio antenna.

The satellite radio antenna is preferably a ground-independent antenna, in that it is preferably either a helical design or a patch type. The position of the satellite radio antenna is preferably at a location on the television/FM radio antenna that will minimize interference between the two. Specifically, these positions are "null-points", and are shown in Figure 1 of the drawing.

There are two "null-point" regions based upon interaction. One "null-point" region includes locations that are naturally occurring combination points between the relatively low frequencies (VHF) and the relative high frequencies (UHF) of the television reception bands. Thus, higher frequency signals that are found in the satellite radio bands may be added at these particular "null-point" locations. The most efficient combination point on a multi-element antenna, such as the multi-dipole (log-periodic) antenna shown in Figures 1 and 2 as the preferred form for the television/FM radio antenna, would be between the UHF and VHF sections of the antenna.

At this particular juncture (between the UHF and VHF sections of the antenna), connection to the satellite radio antenna can be made mechanically only or both mechanically and electrically. A mechanical connection is one in which the satellite radio antenna is mechanically mounted to the boom which supports the various dipole elements (both radiators and reflectors) of the multi-element television/FM radio antenna, but where the

satellite radio antenna does not interface directly with the multi-element antenna. The satellite radio antenna output is through a separate electrical line, usually a coaxial cable, which would run into the house or dwelling place in parallel with the television/FM radio antenna coaxial cable.

Alternatively, the satellite radio antenna may be coupled to the television/FM radio antenna both mechanically and electrically. It may be not only securely mounted to the boom of the log-periodic television/FM radio antenna, but it also may be electrically connected thereto in at least one of two ways. One way is through a filter system which is commonly known as a diplexer or triplexer. The diplexer would combine the satellite radio signal and television/FM radio signal onto a single coaxial cable. The triplexer would combine the VHF, UHF, FM radio and satellite radio signals onto a single coaxial cable through a filtering circuit.

Alternatively, the satellite radio antenna may have a direct electrical connection to the actual multi-element television/FM radio antenna itself, and this should be done at the boom location.

The other of the two "null-point" regions where the satellite radio antenna may be coupled to the television/FM radio antenna would be at a location on the boom itself, with a connection being either mechanical only or both mechanical and electrical, as described above. It is important that the connection be at the boom itself because of the minimal amount of current that flows at this juncture. The minimal current flow results in minimal interaction between the satellite radio antenna and the television/FM radio antenna.

Figure 1 shows a top view of a log-periodic (multi-element) antenna 2, and the various "null-points" 4 where the satellite radio antenna 20 may be electrically and/or mechanically coupled thereto. The log-periodic antenna 2 includes a VHF (very high frequency) portion 6 comprising elements 8 (i.e., reflectors and radiators) N, N-1, through 1, as shown in Figure 1 of the drawing. The UHF (ultra high frequency) portion 10 of the multi-element antenna is shown with smaller, multiple elements 14 than those of the VHF portion 6 attached to the same boom 12 which supports the VHF elements 8. The juncture between the two portions 6, 10 is referenced by the letter A. The elements 14 of the UHF portion 10 of the antenna are labeled as M, M-1, through 1. The elements of each of the VHF

and UHF antenna portions are dipoles formed of spaced apart elements residing in one plane and traversing the boom 12 in a perpendicular direction to the longitudinal axis of the boom.

The "null-point" positions 4 for electrically and/or mechanically coupling the satellite radio antenna 20 to the log-periodic antenna 2 are: 1) at position A, that is, the interface between the VHF portion 6 of the log-periodic antenna and the UHF portion 10; 2) at positions N=1 through N, that is, where the VHF elements 8 are connected to the boom 12; and 3) at positions M=1 through M, that is, where the UHF elements 14 are connected to the boom 12. These are the points where minimal current flows and, accordingly, there will be minimal interference between the satellite radio antenna portion 20 and the television/FM radio portion 2 of the integral antenna.

Figure 2 is a side view of an integrated satellite radio band/television and FM radio band antenna formed in accordance with the present invention. The satellite radio band antenna portion 20 is shown in Figure 2 as being coupled at point A on the multi-element television/FM radio antenna 2, that is, at the juncture between the UHF and VHF portions 6, 10 of the multi-element antenna. Similarly, the satellite radio antenna 20 may be coupled at other "null-points" 4 along the boom 12 of the television/FM radio multi-element antenna 2. Although only the side view of the antenna is shown in Figure 2, it would have the same preferred configuration as the antenna shown in Figure 1. The boom 12 is mounted to a mast 22 which is securely attached to the dwelling place. A linkage 24 is connected between the boom 12 and mast 22 for additional stability and support.

Figure 3 shows, in a simplified form, one form of the satellite radio portion 20 formed in accordance with the present invention. As can be seen from Figure 3, the satellite radio antenna is preferably a helical antenna 21 (more specifically, a quad helix) having one or more elements 26 helically wound on a supporting cylindrical core 28. The helical antenna 21 preferably extends about three (3) inches in a direction that is normal to the plane in which the elements 8, 14 of the television/FM radio antenna reside. It receives "sky"-based satellite signals transmitted in the satellite digital audio radio system (SDARS). It is further preferred to have the helical antenna 21 mounted on a circuit board 30 which includes a low noise amplifier (LNA) 32 positioned at a "null-point" on the boom 12 of the multi-element television/FM radio antenna portion 2.

Alternatively, and as shown in Figure 4, the satellite radio portion of the integral antenna may include a patch-type antenna 34, rather than the helical antenna portion, to receive transmissions from the "sky"-based satellites in the SDARS. A half wave or quarter wave patch antenna may be used, and is preferably electrically and/or mechanically coupled to the boom 12 at one of the "null-points".

The integrated antenna of the present invention provides both conventional television and FM radio reception and satellite radio reception in a single antenna mounted on a single mast. The size of the satellite radio portion 20 of the antenna adds very little weight and wind resistance to the preferred log-periodic, multi-element television/FM radio antenna portion 2, and, if placed at specified "null-points" 4 along the boom 12 of the multi-element television/FM radio antenna, will not substantially interfere with the reception of the television and FM radio signals. If desired, as described previously, connection may be made using electrical components, such as a diplexer or triplexer, to provide each of the satellite radio, television and FM radio signals to the dwelling place on a single coaxial cable. It is also envisioned to be within the scope of this invention that an integral satellite radio/television/FM radio antenna may be formed having a television/FM radio antenna portion in other than a log-periodic (multi-element) antenna form.

Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawing, it is to be understood that the invention is not limited to those precise embodiments, and that various other changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

WHAT IS CLAIMED IS:

1. An integral satellite radio, television and FM radio antenna, which comprises:

a multi-element antenna portion having a boom, a plurality of spaced apart elements coupled to the boom, and a mast for supporting the boom and plurality of elements coupled to the boom, the multi-element antenna having a series of "null-points" situated at various locations along the longitudinal length of the boom; and

a satellite radio antenna portion coupled to the boom at one of the various "null-points" therealong.

2. An integral satellite radio, television and FM radio antenna as defined by Claim 1, wherein the satellite radio antenna portion includes a cylindrical supporting core, and a helically wound element mounted on the core, for reception of "sky"-based satellite transmissions.

3. An integral satellite radio, television and FM radio antenna as defined by Claim 1, wherein the satellite radio antenna portion includes a patch-type element for receiving "sky"-based satellite transmissions.

4. An integral satellite radio, television and FM radio antenna as defined by Claim 1, wherein the multi-element antenna portion includes a VHF (very high frequency) portion and a UHF (ultra high frequency) portion situated on the boom and defining a juncture therebetween; and wherein the satellite radio antenna portion is coupled to the multi-element antenna portion at the juncture between the VHF portion and the UHF portion.

5. An integral satellite radio, television and FM radio antenna as defined by Claim 1, wherein at least some of the "null-points" are situated at the intersections of the elements and the boom to which the elements are coupled; and wherein the satellite radio antenna portion is coupled to the multi-element antenna portion at one of said at least some of the "null-points" located at the intersections of the elements and the boom.

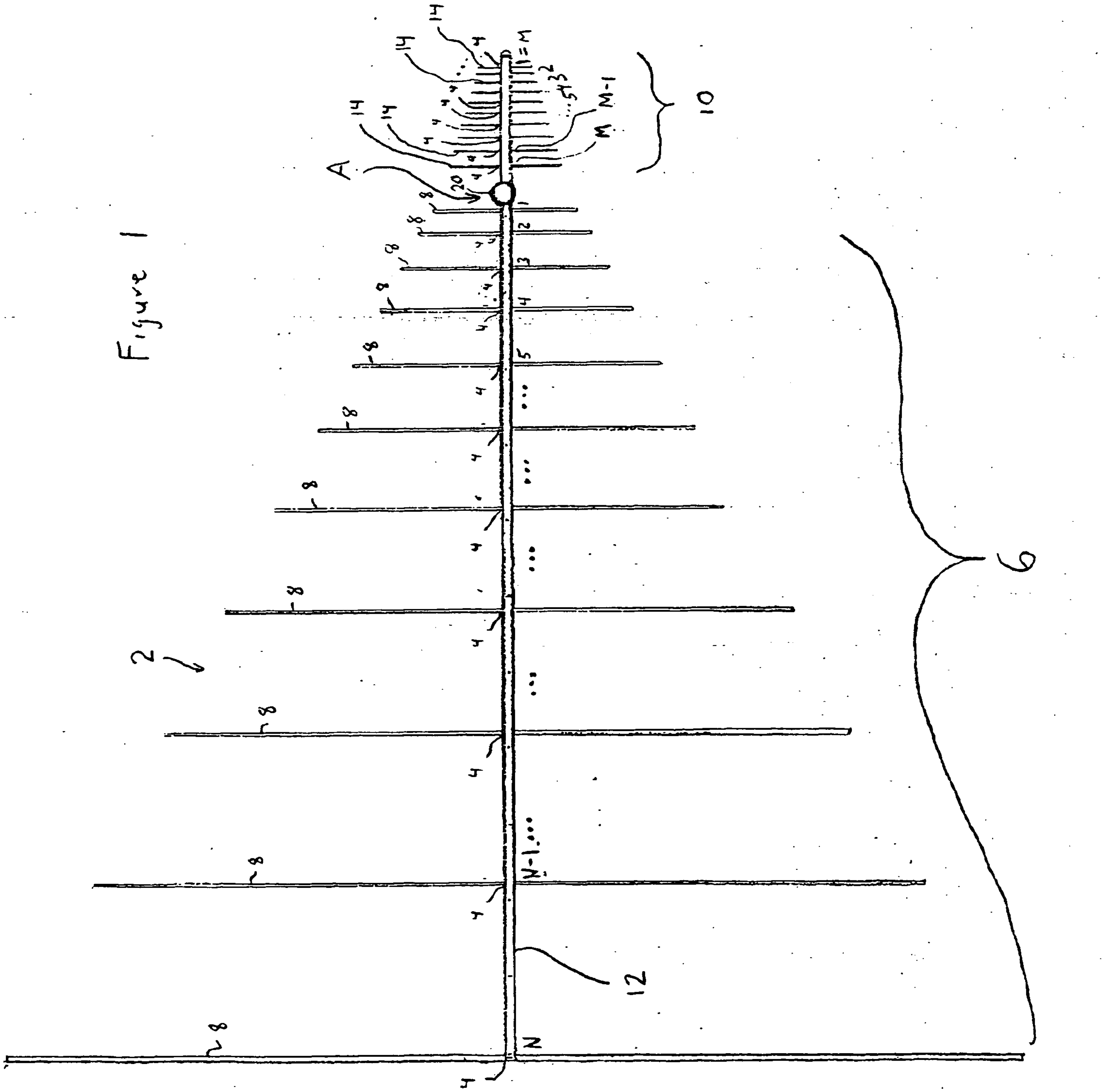


Figure 1

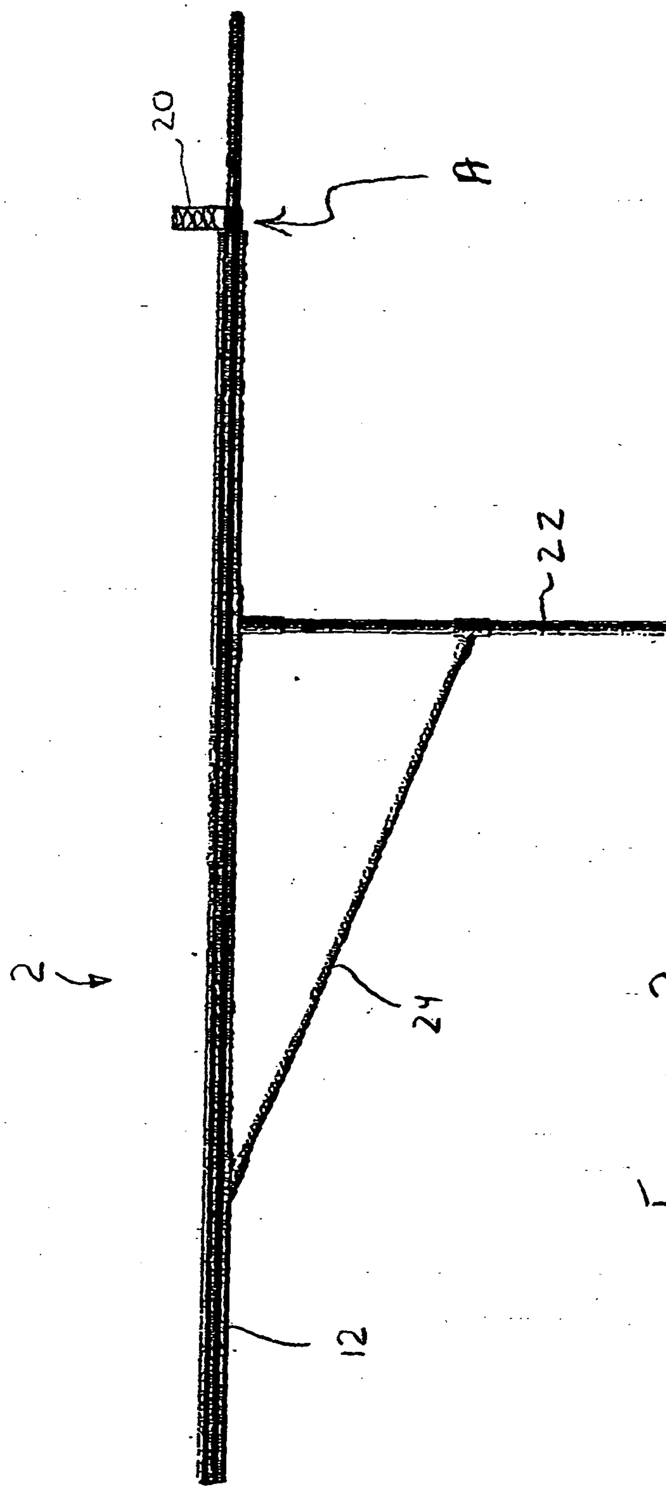
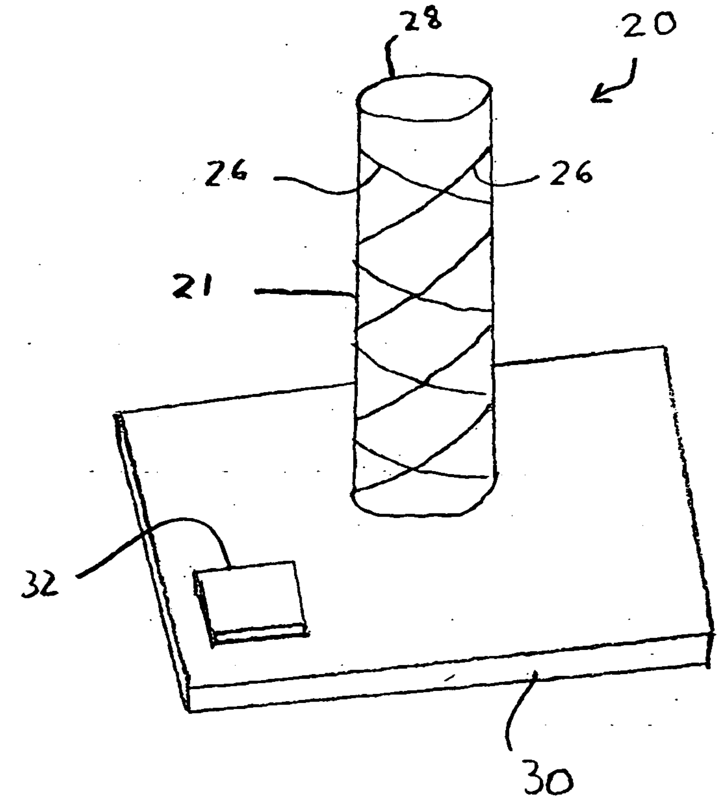


Figure 2

Figure 3



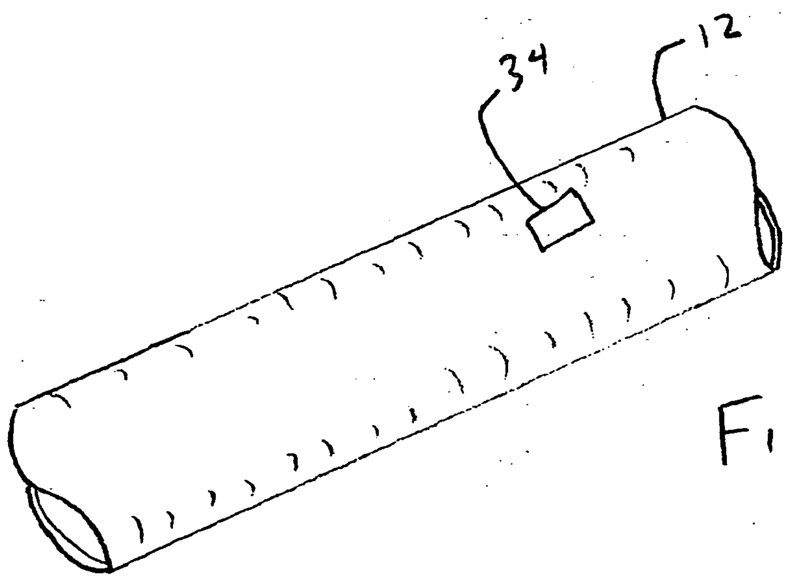


Figure 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/32743

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H01Q 1/00, 11/10
US CL :343/729, 730, 792.5, 895
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 343/729, 730, 792.5, 895, 725, 727

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,021,815 A (BOGNER) 03 May 1977 (03/05/1977), see figure 4.	1-5
A	US 4,977,408 A (HARPER et al) 11 December 1990 (11/12/1990), see figure 1a.	1-5
A	US 6,057,805 A (HARRINGTON) 02 May 2000 (02/05/2000), see figure 2.	1-5
A,P	US 6,329,955 B1 (MCLEAN et al) 11 December 2001 (11/12/2001), see figure 15.	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search

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